

NERVE DISASSOCIATION; A NEW METHOD FOR THE SURGICAL RELIEF OF CERTAIN PAINFUL OR PARALYTIC AFFECTIONS OF NERVE TRUNKS.*

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Summary.—The following is a preliminary report giving the results obtained in treating certain forms of paralysis or paræsthesia due to injury or inflammation of nerve trunks by isolating the affected part of the nerve through an incision, freely opening the nerve sheath, disassociating the component fibers, and isolating the nerve from later fibrous tissue compression. The neurolysis is intended to permit the escape of exudate from within the nerve sheath, to reduce pressure upon individual nerve fibers; to free axis cylinders which have become useless through entanglement in scar tissue, to facilitate the formation of new or the restoration of old nerve paths, and to stimulate desirable trophic changes in the nerve trunk.

The influence of pressure within the nerve sheath as a cause of palsy and anæsthesia was brought to our notice in November, 1905, by a patient who had sustained a small incision of the median nerve from a piece of flying glass. On exposure of the injured nerve it was found that the nerve was not divided, but was the seat of a marked fusiform enlargement. Upon incision of the affected area there flowed from between the nerve fibres a gelatinous and serous fluid. In this patient nothing was done except to make a free longitudinal incision into the nerve. Four days later, upon testing the hand it was found that the area of anæsthesia had decreased

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one-third and that there was a distinct increase in the ability to flex the fingers. The prompt improvement in this patient was very suggestive, and later we gradually developed a method of treating certain forms of neuritis that have produced paresthesia or paralysis and also a possible means of inducing regeneration along nerve paths blocked by areas of cicatricial tissue. Unfortunately, our experience with this new operation, while encouraging, has been limited to four cases, and this preliminary report is made, therefore, with the hope that a wider application may more precisely determine its field of usefulness.

Technique of the Operation.—After sufficiently exposing the affected nerve through an incision, the nerve is isolated from adjacent tissues and a free longitudinal incision of the nerve sheath made. The sheath should be divided, if possible, well beyond the limits of the lesion. The nerve trunk is then lifted upon one or two fingers, held taut, and the nerve fibers carefully separated from each other by means of a small, sharp tenotome. Care is taken to divide as few nerve fibers as possible, although it is aimed to freely separate the nerve fibers from each other. As the nerve fibers become separated, the nerve is transformed from a rounded cord to a flat ribbon-like band of separated fibers. If cicatricial tissue is encountered in the nerve trunk the separation of the fibers is prolonged along straight lines dividing the scar into multiple parallel threads of tissue. Having freely disassociated the nerve fibers, if the nerve were previously imbedded in cicatricial or fibrous tissue it should be removed from this area, or at least isolated from future cicatricial adhesions by the interposition of adipose tissue, strips of which can usually be secured from beneath the skin. In one of our cases, the musculo-spiral nerve was transplanted from the musculo-spiral groove into the subcutaneous fatty tissue. In two other cases we have laid thin strips of adipose tissue between the nerve and its normal bed. Of seven cases in which we have partially or thoroughly disassociated nerve fibers, in only one were we able to detect an increase of the paralysis immediately following the operation, while in

several there was an almost immediate increase of function in the affected nerve field. In three instances the nerve trunks were split for purposes of nerve transplantation. During the operation it is important that the nerve be handled gently, be not subjected to strong traction, and that the knife be sufficiently sharp to separate, without unnecessarily pulling, tearing, or bruising the nerve fibers. Theoretically, it may be assumed that the operation may be of benefit in a number of ways as follows:

FIRST. The relief of tension within the sheath.—The free disassociation permits the immediate escape of interfibrillar exudate. The pressure of the constricting nerve sheath is relieved, intraneural collections of fibrous tissue are divided and constricted nerve fibers freed. This is well shown in Case 1.

SECOND. The operation may be useful in permitting a rearrangement of nerve paths.—In the process of disassociation it is inevitable that many axis cylinders will be divided or torn free from their connections. Thus there is left along the tract of the operation, numerous free ended axis cylinders in condition to form new anastomoses with a possibility of the reestablishment of many nerve paths previously interrupted. For example, in brachial birth palsy, or after traumatic division of nerves, the divided nerve fibers may become entangled in the new forming connective tissue and remain buried and incapable of function. In the process of disassociation these nerve fibers are freed from their entanglements, divided, and are left adjacent to other divided fibers, with some of which they may anastomose, reestablishing the function; or again, other divided short segments of nerves may by forming attachments at each end serve as bridges over the gap caused by the injury.

THIRD. The operation may facilitate the bridging of cicatricial gaps in nerves.—If a nerve has been divided and the ends finally joined by a mass of scar tissue, say one-half inch or more in length, the separation and freeing of nerve fibers above and below the fibrous area, and the splitting of the

cicatricial connecting band into threads of tissue with innumerable interspaces between, should, theoretically, at least, place the freed axis cylinders in a most favorable condition for growth and ultimate anastomoses along the grating trellis-like strands of fibro-connective tissue. It would seem that such a fibrillated fibrous bridge should give much better results than where the divided and separated nerve ends are bridged by calvar or other foreign material. Moreover, all residual nerve filaments are conserved and there is no sacrifice of nerve tissue such as occurs when the cicatricial area is excised or resected. While after primary nerve injuries the immediate exudate and hemorrhage may be prejudicial to anastomosis; in nerve disassociation the field is practically free from blood, the opportunities for drainage are good and there should be little interference by the pressure of exudates.

CASE I.—Partial division of the median nerve with localized infiltrative neuritis. Prompt partial return of function after incision into the nerve.—M. G., 32 years old. Well nourished. Previous history negative. In September, 1905, a piece of glass from an exploding bottle of soda water made a short incision about two inches above and one inch internal to the line of the internal condyle of his left arm. This was followed by inability to flex the index and second fingers and anesthesia of the entire palmar surface and the terminal portions of the dorsal surfaces of the first two fingers. There was no paralysis of the thumb, and aduction and abduction of the fingers were retained. Two months later the patient had partially regained the power of flexion of the second finger. On November 22, 1905, the patient entered the Samaritan Hospital. The median nerve was exposed opposite the superficial scar. In this area the nerve showed a grayish, fusiform expansion of about three times the calibre of the normal nerve. This enlargement of the nerve trunk was freely incised in a vertical direction and a marked gelatinous and serous infiltration between the fibers found. The wound was closed in layers without drainage. Four days later the area of anesthesia over the palmar surfaces of the finger was found to have decreased about one-third. He could partially flex the first finger at the knuckles, but not at the interphalangeal joint. After

this immediate improvement there was little change for ten months. Recently a progressive increase in power has been reported. In this case the thorough disassociation of fibers used in the later cases was not carried out.

CASE II.—Progressive musculo-spiral neuritis following traumatism. Nerve-stretching; temporary relief from pain and complete palsy of musculo-spiral nerve. Nerve disassociation, with immediate partial return of motion and relief from pain, secondary return of some of the symptoms, and final progressive improvement.

History.—A. S., 32 years old. (Patient of Dr. W. A. Steel.) Mill hand. Previous history negative.

History of Neuritis.—Six years ago patient fell from a bicycle bruising an area over the left musculo-spiral groove. Following the injury an intermittent neuralgia appeared in the field of the musculo-spiral nerve and continued for five years. Ten months ago the neuralgia became constant and there was a gradual decrease in the power of the extensor muscles of the forearm. Rest, counter-irritation, and internal medication failed to relieve the symptoms.

Operative Treatment.—In September, 1906, the patient entered the Samaritan Hospital, the nerve was exposed in the musculo-spiral groove (Dr. Steel), freed from its adhesions and stretched. Complete musculo-spiral paralysis followed the operation. The pain was relieved for a few weeks, but gradually returned with increasing severity. There was partial ability to flex the fingers and thumb (median and ulnar nerve), but this was impaired. Electricity and massage were used. Three months later, the pain continuing with great severity, the nerve was exposed (Drs. Steel and Babcock) over a distance of seven inches and it was found shrunken and grayish in color and adherent over an area one inch in length corresponding to the site of the injury. The nerve was isolated, the nerve sheath opened, and the nerve fibers freely disassociated from the upper fourth of the humerus to the elbow. The nerve was then lifted out of its groove between the heads of the triceps and transplanted into the deep subcutaneous fat. The immediate effect of the operation was relief from the pain and the ability to extend the fingers and wrist from the splint, indicating some restoration of the musculo-spiral function. About a week later there was a

partial return of the pain, and this continued for two months after the operation, when the nutrition of the hand and forearm having improved there was a gradual cessation of pain and return of power. Three months after the operation there was no pain in the peripheral distribution of the musculo-spiral nerve, but some tenderness and pain in the axilla and over the clavicle. Flexion, extension, and rotation of the hand and fingers are nearly perfect. Electricity and passive motion have been used, beginning two weeks after the operation. In this case the striking features are the immediate disappearance of the wrist-drop following the neurolysis; second, the return of pain and loss of power, probably from the exudate poured out during the reparative process, and the final relief from pain except in an area proximal to the field of operation.

CASE III.—*Intractable sciatica. Nerve-stretching followed by temporary relief from pain and complete palsy. Return of pain. Disassociation of posterior tibial nerve followed by partial return of motion in twenty-four hours and relief from pain in the field of the disassociation.*

History.—S. K., age 21, single. Factory girl. Previous history negative. Had suffered with neuralgic pains along the course of the left sciatic nerve for eight months not relieved by various constitutional and local measures, including injections about the nerve trunk. She had also been in one hospital for treatment for six weeks and in a second for one week. October 24, 1906, about eight months after the development of the pain, she entered the Samaritan Hospital, and the day following, under spinal anæsthesia by stovaine, the left sciatic nerve was exposed and thoroughly stretched. The operation was followed by immediate relief from pain and complete paralysis of the leg and foot. Six days later the patient began to complain of some return of the pain. As the pain continued and proved progressive, especially in the calf of the leg, on November 26, about one month after the first operation, the patient, under spinal anæsthesia by tropa-cocaine, was treated by exposure and thorough disassociation of the upper third of the posterior tibial nerve. The nerve was then insulated by strips of adipose tissue taken from under the skin and the wound closed in layers without drainage. Twenty-four hours after the operation there was ability to flex the toes one-fourth of the normal range. There

was wound soreness, but relief from the neuralgic pain; later there was some return of the pain in the foot, which subsided under hot baths, so that the patient is now nearly free from severe pain in the leg, although there are some pains about the upper thigh and hip. There is anaesthesia of the anterior surface of the foot and leg, while sensation is present over the posterior surface, and there has been a gradual subsidence of the paralysis. There was in this case, therefore, a partial but immediate return of function in the distribution of the nerve operated upon, which has persisted, while anaesthesia continues in the distribution in the anterior tibial nerve, the branch not treated by disassociation.

CASE IV.—Intense neuritis of the forearm chiefly involving the field of the median nerve. Disassociation of median nerve followed by increase of paralysis, but marked relief from pain. Gradual resumption of power and increasing relief.

Mrs. H. T., age 48, previous history negative except two attacks of typhoid fever about the age of puberty. A year ago, one month after moving into a damp house, she noted a sensation of coldness in the posterior surface of the left hand, between the thumb and index finger. The application of water would produce a chill. Increasing lancinating pains shooting from the tip of the index finger along the inside of the arm to axilla developed, with tenderness. The fingers became stiff, could be flexed only partially and at times not at all. The third and fourth fingers remained normal. The pain became so intense that for nine weeks preceding her entrance to the hospital, three hypodermies of morphine were injected into the arm daily. At the Samaritan Hospital, March 26, 1907, the lower third of median nerve in the arm, and likewise the lower half of median nerve in the forearm were exposed by a longitudinal incision above the elbow and one above the wrist, isolated, the nerve sheaths carefully divided and the nerve fibers thoroughly disassociated. Following the operation there was a loss of motion of the first two fingers and thumb, with a sense of marked anaesthesia. The pain was much less intense and the tenderness much reduced. There was some return of motion within a week. Three months after the operation the patient could sleep comfortably at night, had partial flexion of all fingers, some sense of anaesthesia, and increasing freedom from pain. Future experience may prove that it is unwise to disassociate two areas of a single nerve trunk at one time.

Of the four cases in which an operative disassociation of nerves was carried out, three were for painful conditions and these patients obtained marked relief by the operation. In all four there were paralytic symptoms and in three of these cases there was an immediate decrease in the palsy following the neurolysis. In the remaining case, one in which a single nerve was disassociated, along two different areas there was a transient increase in the paralysis. In two of the cases nerve stretching had previously been employed, had failed to give continued relief and had produced immediate palsy. For the present we may conclude:

First.—That the surgical disassociation of nerve fibers may be carried out without producing gross evidence of reduction in the conducting power of the nerve.

Second.—Disassociation probably is not as apt to produce paralysis as thorough nerve stretching.

Third.—That in certain cases of neuritis, nerve disassociation is less dangerous and more potent in relieving symptoms than nerve stretching.

Fourth.—In certain cases of motor paralysis following inflammation or injury of nerve trunks, disassociation may be followed by a remarkable and almost immediate return of some of the function.

Fifth.—In the treatment of certain forms of peripheral paralysis due to interruptions of nerve paths by masses of fibrous or other tissue, the operation of nerve disassociation from its apparent safety and conservatism is deserving of trial. Especially do we feel that it is warranted in cases of brachial birth palsy where no gross lesion is found in the nerve trunks or where extensive resections, anastomoses, or forms of nerve bridging by catgut or other foreign materials would otherwise be employed.